Monitoring and Adaptive Management

One of the 8 required elements for inclusion in the Comprehensive Wildlife Conservation Strategy (CWCS) is monitoring Species of Greatest Conservation Need (SGCN) and their habitats. Beyond meeting this requirement, the CWCS provides the impetus to states and their partners to develop and implement a comprehensive monitoring program to supplement or simply organize the often disjoint monitoring that already occurs. The added value of a comprehensive program is the coordination and broad application of data for many programs within DEC, our sister agencies, and other conservation partners that is greatly needed for all fish and wildlife resources and the habitats that support them, including SGCN.

There are several facets to the monitoring as outlined in the enabling legislation of the State Wildlife Grants Program. First we need to assess or inventory the ongoing and existing monitoring data relevant to SGCN and their habitats across the state. We must also identify gaps where such assessments do not exist. These assessments will provide a starting point and help track progress toward improving the health of these populations and their habitat statewide.

Second, in cases where monitoring or baseline assessments of some species and habitats do not exist, efforts to develop such assessments must be made. In the case of habitats, it is likely that a combination of remote sensing and on-the-ground assessments will be used. In the case of SGCN, surrogate indicator species may be used if direct observation techniques are not possible or are impractical.

Third, assessment and monitoring of threats to SGCN and their habitats is necessary. It is likely that this will require the development of indicators for some or all of the severe threats to SGCN and their habitats.

Fourth, we must assess the progress of the State Wildlife Grants program toward stabilizing or improving the status of SGCN and their habitats. In the case of directly funded SWG projects, final reports and data will be retained by the state. Updates of the overall condition of SGCN will be made at the time of updates to the CWCS or in grant reports made to USFWS. In the case of the extensive monitoring and assessment that goes on outside the sphere of the State Wildlife Grants program, we must be diligent in reaching out to share and use these data to complete the overall picture of wildlife and habitat health in New York.

There are several key concepts to bear in mind when contemplating a data management system of this magnitude:

- Collaboration with existing monitoring efforts at universities, government agencies, and not-for-profit partners. Outreach and diligent investigation into ongoing monitoring across the state and relevant national monitoring is crucial.
- Development of efficient information sharing among partners to maximize the benefits of limited funding.
- Development of minimum standards across these programs wherever possible.

- Long term stewardship of data sets, and technological and practical accessibility of these data sets.

Regardless of the resource of concern, all monitoring programs follow a similar cycle:

Monitoring & Assessment of Resource
↓
Threshold Values Comparison
↓
Determine Threats and Sources of Impact
↓
Prioritize/Rank/Target Resource
↓
Develop/Implement/Modify Management Measures
↓
Monitor Effectiveness of Actions
↓
Repeat Cycle

By asking the following questions, a basic framework of key elements of a monitoring program can be identified:

Purpose/ Objective**:**	Why are we creating a monitoring program?
Method:	How will this objective be achieved? ✓What are we going to monitor? ✓What scale is appropriate to achieve this objective? ✓Where are we going to sample? ✓How are we going to measure? ✓When are we going to sample? ✓Who will conduct monitoring?
Analysis:	How will the data be stored and handled?
Application:	How will we define thresholds? ✓How will the data be used to meet our objectives?
Management:	What is the long-term goal or time frame for adaptive management?

In order to adequately monitor SGCN, their habitats, the effectiveness of proposed conservation actions, and the adaptations needed in response to new information or changing conditions, the following 10 elements of a monitoring and assessment program are crucial:

I. Develop program strategy
II. Define program objectives
III. Select data management procedures
IV. Select survey design and methods
V. Account for program infrastructure and support

VI. Develop quality assurance program and project plans
VII. Select data analysis procedures
VIII. Determine reporting framework
IX. Conduct programmatic evaluations

I. Program Strategy

The strategy will address the monitoring and assessment needs of all SGCN and their associated aquatic (freshwater, estuary, marine) and terrestrial habitats in New York State. This assessment will also include a plan for the State and its partners to address the remaining program elements in a timely manner. In addition, the strategy will identify technical issues and resources such as staffing and infrastructure needed in order to carry out a meaningful monitoring program. Finally, the monitoring strategy will identify specific long-term goals and a time frame for the successful achievement of those goals within an adaptive management framework.

II. Program Objectives

Defining objectives and identifying monitoring questions is a critical yet difficult first step in developing an efficient and meaningful program that addresses management and conservation needs. These objectives/questions will be clearly defined and based on: the long term goals of the State Wildlife Grants program, an interdisciplinary collaboration among key partners and experts, and an evaluation of the best available data for SGCNs and their associated habitats. This approach will also allow the DEC to prioritize monitoring targets and questions based on rarity, quality of data and public value. For example, an analysis of existing data for an individual SGCN may reveal a lack of quality data on the distribution of this individual species. Objectives would therefore be guided to collect the baseline information needed to effectively define the distribution of this species throughout the state. Questions related to this objective could include: What is the current distribution of this species? How is this species affected by local land management activities and human disturbance? Where are the high quality habitats for this species? Each objective will drive the monitoring scale, sampling design, methods, analysis, implementation, quality assurance, costs, and reporting of activities. Once effective objectives are in place, monitoring data can provide critical information about location, condition, function, and status and trends of the target resource. In addition, this data can be used to develop management thresholds, identify and assess threats and their sources, and evaluate specific management actions.

III. Data Management Procedures

An accessible electronic data management system must be identified in the initial stages of developing a monitoring and assessment program. The ability to retrieve and share collected data with partners for use in other studies and projects should be a primary goal of the program. This particular element requires careful thought and anticipation of the needs of the data gatherers (producers) and data users. At the state level, development of a data directory may be most appropriate to maintain the strength of individual data sets. Such a directory has precedent in the New York State Geographic Information Systems Clearinghouse maintained

by the Office for Technology, or DEC's own master Habitat Data Bank. There are also myriad individual databases related to fish and wildlife species. Two examples from within DEC include the New York Natural Heritage Program database and the Bureau of Fisheries database.

The development of a derivative database with simple fields common to some or all of the extant data sets regarding SGCN and their habitats may be a desirable pursuit as well, though potentially complex. Incorporation of, at a minimum, simple spatial data for all data sets is crucial. There are a number of valuable procedures and sophisticated computer programs that can be applied to such database development. Workshops on advanced data storage and management will be conducted as the monitoring objectives become more clearly defined. Important considerations for database development include:

- Specific attention given to the needs of sensitive species or habitats (Following DEC Natural Heritage Program protocol)
- Access for all contributing and participating partners
- Georeferencing data when possible/applicable
- Meeting data quality standards defined in quality assurance programs
- Incorporation of metadata

IV. Survey Design and Methods

The monitoring objectives and questions will define ideal survey design and methods of collection. Once the objectives and targets have been clearly identified, sampling designs and methods that are appropriate for both species and habitats will be described. The key will be to create a sampling strategy that allows for estimates of statistically significant changes in the status of target resources (Vos et al. 2000). New York will cooperate with ongoing national efforts by USGS to create and coordinate SWG monitoring resources at the national level.

Once baseline data has been organized (from the myriad extant monitoring efforts and data sets) or collected through new projects, measuring the condition of these resources can either be done directly, through estimates of population size and habitat area, or can be indirectly suggested through the use of specific indicators. Environmental indicators are often proposed as time and cost efficient surrogates of ecological function, status or condition. For example, nutrient levels and Secchi disc measurements are used to evaluate water quality; while indices of biological integrity (IBI) assess stream, river, and wetland condition. Analogous indicators, or surrogate species, have also been proposed for monitoring distribution and population trends in other co-occurring species. However, the use of indicators has been controversial in the scientific community because populations are highly variable, responses of individual species may not represent trends in co-occurring species and correlational relationships are rarely rigorously tested. The use and development of indicators in any monitoring system must be carefully applied and rigorously tested. After monitoring objectives and questions have been clearly developed, indicators may be evaluated for their ability to represent attributes of a community or habitat that are too difficult or expensive to measure (Landres et al. 1988). These attributes can include the health and integrity of target habitats, the status of related species or the presence of high biological diversity.

Although related, the techniques employed for monitoring species and habitats differ. Sampling designs will thus be based on the monitoring questions and scale (watershed basin, landscape, community, habitat, individual populations, genetic), desired statistical power and cost effectiveness of implementation. Once this framework has been approved, a number of issues concerning sampling effort will be addressed. For example, how large will the sample area be? What is the sampling frequency? How many sampling sites and how many replications are needed for the desired statistical power? (Vos et al. 2000). In addition, state agencies are uniquely challenged with gaining access to private lands. Survey designs will initially focus on public lands, while the state develops new or additional protocols for voluntary participation or other private land owner initiatives.

MONITORING CRITICAL HABITATS

Habitat monitoring generally occurs at the landscape scale. Remote sensing and GIS will play an important role in measuring landscape patterns, tracking key habitats and identifying sites for longer-term monitoring. Monitoring questions at this scale will include: How much available habitat is there? Where is it located? And, is this habitat currently protected? (Gaines et al., 1999). Additionally, the dynamics of habitat change brought about by ecological succession, agriculture, timbering and human population distribution should be recognized and monitored at a general level to provide context for other efforts. Sites will then be identified that can represent a range of physical and biotic conditions for target habitats and may also be selected for the monitoring of SGCNs. An additional important component of this type of monitoring will be identification of threats and trends in major habitat types such as forests, grasslands, early successional habitats, wetlands, and waterbodies.

Monitoring habitats at the community level will provide an important connection between landscape scale processes and local conditions of target habitats and their associated SGCNs. Site selection at this stage will influence both our understanding of the current status of target habitats and how their condition varies over a range of management, landscape or geographic conditions. Reference sites will also be identified to represent habitats in the best available condition. Sample sites can then be compared to the reference condition to ascertain impairment, if any. For example, it may be critical to understand how a specific management action is having an effect on a target habitat. Selection will therefore focus on identifying sites with and without this management, and quantifying the differences in community composition and function.

Once the monitoring objectives and sampling framework are in place, there are a number of sampling techniques that can be used at the landscape or community level. Geographic Information Systems (GIS) and remote sensing will be used to ascertain distribution and abundance of resources and condition of large scale sampling areas, as was done in the New York GAP Analysis Project and the EPA's Multi-Resolution Land Classification project. It can build on existing databases and provides coarse information quickly to resource managers. At the community level, rapid assessment programs (RAP) can provide state agencies with a first cut evaluation of the status and quality of target communities. There are number of existing frameworks and peer reviewed protocols that will be considered for both terrestrial and aquatic RAP (U.S. EPA:

http://www.epa.gov/owow/monitoring/rbp/; Center for Applied Biodiversity Science: http://www.biodiversityscience.org/xp/CABS/research/rap/terrestrial_rap/terrestrap.xml). In addition to GIS and RAP, indices of biotic integrity are also useful in assessing the overall integrity of target communities. Currently the Division of Water at DEC uses a locally calibrated index of biotic integrity (IBI; Karr, no date) as an indicator of the health of aquatic resources within HUC (hydrologic unit code) watershed basins. This approach may also be useful in terrestrial systems, though; a terrestrial IBI has yet to be rigorously tested. Evaluation and implementation of both RAP and IBI will occur after setting clear monitoring objectives. The applicability of the New York Natural Heritage Program's ecological community classification system that has been applied to public and private lands throughout the state will also be evaluated.

MONITORING SGCNS

Monitoring of SGCNs will generally occur at the species or population level. Because populations are difficult to estimate accurately, indices are often used as surrogates of population size (Gibbs et al., 1998). Therefore, after evaluating existing data for individual species, a sampling scheme that incorporates direct measurement of abundance indices or presence/absence data, when appropriate, will be implemented. Monitoring questions at this scale will include: Are the existing populations increasing or decreasing? Where are these populations persisting? And how are management activities affecting populations?

There are a number of sampling designs that can be used to effectively answer species level monitoring questions. A sampling design based on random site selection allows conclusions from sample data to be generalized over the larger area from which the sites were drawn (Vos et al., 2000). However, if the populations being sampled cannot be considered homogenous, then a stratified random sampling technique is preferred. For example, if we would like to know what the population trend of a specific species is throughout the state, it may be important to stratify the sampling design by watershed basin or ecozone. Additionally, if the purpose is to evaluate the effects of specific management actions on individual populations, site selection will again focus on identifying sites with and without this management, and quantifying differences in abundance. A final and key consideration in choosing a sampling design is the statistical power. The statistical power is defined as "the probability that a monitoring program will detect a trend in sample counts when the trend is occurring, despite the noise in the count data" (Gibbs et al., 1998). The power will depend on how much noise there is in count data because of measurement error, sampling scheme, and spatial/temporal variability. Estimates of this "noise" can be quantified using pilot studies or from references in the literature (see especially Gibbs et al. 1998). Incorporating a power analysis into the sampling design will allow the DEC to define how many sites will be needed to detect a 10, 25, or 50 percent change for any target species.

Once the objectives and sampling framework are in place, sampling techniques to measure presence, abundance, or population viability will be selected. There are a number of peer reviewed techniques for collecting data on individual species (Clarke, 1986; Heyer et al., 1994; Wilson et al., 1996). Sampling method will be chosen based on: field verified techniques, reliability and cost-effectiveness (Vos et al., 2000). Reliability will be maximized by using simple field techniques

whenever possible (Vos et al., 2000), and by quantifying the level of expertise of data collectors (agency biologists vs. volunteers). Cost-effectiveness will be evaluated by balancing the costs (labor hours and equipment) with effectiveness (power).

V. Program Infrastructure and Support

In order to develop and implement a useful and meaningful monitoring program, adequate resources and logistics must be identified up front. This includes funding for staff, training, laboratory costs, field activities, office equipment and supplies, and data management and analysis. These considerations will be defined by the monitoring objectives, sampling design and cost-benefit analysis. This stage will address questions such as:

- How many people will be needed?
- What type of training will they need?
- How will protocols be developed for reporting efforts?
- Who will be able to retrieve or use the data and what support/constraint will that require?

VI. Quality Assurance Program Plan

Data quality assurance (QA) is an important consideration for any monitoring effort. Quality assurance plans are used to allow for repeatability, and prevent errors in monitoring, laboratory work, and data analysis and reporting. There are a number of techniques that will be reviewed in order to maintain the reliability and repeatability of data collection. Currently, the DEC Division of Water utilizes a quality assurance program plan outlined in their Analytical Services Protocol, a requirement of EPA mandated water quality monitoring programs. All monitoring efforts that fall under the DEC Division of Water will continue to apply these protocols for data quality management. In addition, this type of quality assurance plan can be further developed and modified to meet the monitoring needs for SGCNs and aquatic and terrestrial habitats. Important considerations for QA will include: scientific validity, precision and accuracy, comparability and legally defensible. Approaches will differ depending on the type and experience of the observer and the objectives of the monitoring effort. For example, while citizen science can be an important component of any statewide inventory, it will be critical that skill level and collection techniques are considered when using volunteer data to assess the status of target resources.

VII. Data Analysis Procedures

Data analysis procedures used to evaluate collected monitoring data should meet specific monitoring and assessment objectives. The analysis methodology needs to influence each phase of the monitoring program: design and use of field data sheets, compilation of data, specification of statistical analyses, analysis of raw data, integration of all collected data, and assurance of quality assessments. All data analysis will occur at regular intervals and will be based on the most appropriate and up to date statistical techniques.

VIII. Reporting Framework

Results from a monitoring and assessment program should support management decisions. Project report format, style, audience, and peer review requirements should be addressed in the initial stages of a monitoring program. Because federal and state agencies are combining to affect a national CWCS, reporting format should likely be developed in concert with federal guidelines. Pittman-Robertson, Dingell-Johnson, or similar program reporting procedures could serve as prototypes for development of a reporting scheme that will satisfy this need.

IX. Programmatic evaluations

Regular reviews of each part of a monitoring program will ensure that the overall program is meeting the monitoring objectives, stated targets and needs of resource managers. The sampling strategy will be regularly evaluated to adjust for updates in ecological knowledge or sampling technique, shifts in the priority of target resources or changes in cost-effectiveness analyses. Currently the CWCS is on a mandatory 10 year cycle. However, appropriate time frames for analysis will vary according to habitat type, species natural history traits, and management actions. This suggests that although the "monitoring program" will be reevaluated every 10 years, individual monitoring efforts should tailor programmatic evaluations to their target resources. For example, monitoring the effect of a specific management action on an invertebrate population would require a much shorter time frame than monitoring the same management action on a population of terrapins. Therefore, once individual monitoring efforts have been established, programmatic evaluation time frames should be created with reference to the life history traits and temporal variability of the target resources.

Approach to Developing a Resource Monitoring Program in New York

The NYS Department of Environmental Conservation does not currently have the staff or resources to conduct a statewide monitoring program of SGCN and their habitats. The CWCS process provides the impetus to states and their partners to develop and implement such a program. In developing this monitoring plan, the DEC will be able to address each of the ten elements through a series of time sensitive phases (see Monitoring Table 1). Initial phases allow for the evaluation of existing data and identification of habitats, taxa or watersheds that lack quality information. Later phases will incorporate each of the ten elements into the design and implementation of a comprehensive SGCN monitoring program in an adaptive management framework. Although the timeline identifies elements that will be specifically addressed during each phase, all elements will be considered throughout the design and implementation of the resource monitoring program.

Monitoring Table 1. Phased approach to a comprehensive monitoring program for SGCN and their habitats in New York.

Phase	Objectives	Elements	Time table	Projected Outcomes
1	**1)** Identify stakeholders, key partners and existing databases. Create a partner workgroup to create monitoring framework. **2)** Identify and begin acquisition of relevant remote sensing and GIS data. **3)** Create geo-referenced central data directory that identifies existing SGCN data. **4)** Use baseline information to define purpose, objectives and questions in monitoring program and support management decisions. **5)** Develop a statewide protected lands GIS data layer.	I, II, III	Years 1-5	**1)** Identification and prioritization of SGCNs and their habitats that lack sufficient distributional and abundance data. Identified lead partners for each. **2)** Updated maps of target habitats, areas and watersheds in New York State **3)** Appointment of a database manager who will be responsible for the creation of a centralized and accessible data directory for current and future monitoring efforts **4)** Clear purpose, objectives and monitoring questions developed for implementation. Identification of possible environmental or SGCN indicators.

Monitoring Table 1. (cont'd)

Phase	Objectives	Elements	Time table	Projected Outcomes
2	**1)** Design ideal sampling strategy for individual species, habitats, and long term data collection-incorporate data quality concerns into design **2)** Account for program infrastructure and support **3)** Evaluate data analysis techniques **4)** Establish reporting framework	IV, V, VI, VII, VIII	Years 5-8	**1)** Identification of new sampling and data collection needs (volunteer vs. expert field work). Design and implementation of pilot studies **2)** Cost benefit analysis will help refine data collection techniques and prioritize target resources **3)** Identification of appropriate statistical methods **4)** Documentation of how the state expects reports to be generated, reviewed, published and distributed
3	**1)** Analyze pilot monitoring data and evaluate management actions **2)** Evaluate ranking of target resources **3)** Propose changes in data collection and management based on data analysis and budget needs **4)** Report findings to stakeholders, partners and the public	IX	Years 7-10	**1)** A comprehensive analysis of the status and distribution of SGCNs and their habitats **2)** Reassess the goals and targets for the DEC monitoring program in an adaptive management framework **3)** Strengthen the existing monitoring framework with new information and current budgetary constraints **4)** Creation of a publicly available and peer reviewed update of the CWCS with trend analysis and full transparency and data sharing (while maintaining appropriate protections for sensitive species)

Phase I

STEP 1. IDENTIFY STAKEHOLDERS, KEY PARTNERS, AND EXISTING DATABASES

Collaboration is a key element in any successful monitoring program. As such, the first step in development will be to hold several meetings with key partners in order to build on past and present monitoring efforts identify baseline data and form a stakeholder committee. Such partners include, but are not limited to, other divisions in DEC, other state agencies, federal agencies, universities, non-governmental organizations (NGO), museums, and the Tribal Nations of New York. These meetings will initiate much-needed communication and consistency in monitoring, and provide the springboard for sustained communication in the future. Committee sub-groups may be formed and lead partners will be identified to address specific monitoring needs.

It is important that we build upon existing monitoring and data assessment programs for efficiency, affordability, and continuity reasons. There are a number of wildlife and habitat databases that, although collected using a variety of techniques and at differing scales, will allow some assessment of the distribution and abundance of SGCNs and critical habitats. The information that can be gleaned from this data depends on the length of the study, and the quality and extent of the data collected. For example, while the NYS Breeding Bird Atlas has collected presence data for breeding birds throughout the state for both 1985 and 2005, the Breeding Birds Survey has collected relative abundance data along road transects since the 1960s. Both of these databases will be useful for understanding statewide distributions and local abundances of some SGCNs. Additional survey and monitoring efforts include: Christmas Bird Count, Birds in Forested Landscapes, Herpetofaunal Atlas, Marsh Monitoring Program, Natural Heritage program, fisheries surveys, and many, many other efforts carried out by government agencies, colleges, universities and private entities.

The application of existing remote sensing and GIS data will also play an important role in identifying the distribution of key habitats and associated species. For example, the New York State GAP (GAP) project, completed in 2001, has computerized the geographic distribution of plant and animal species in NYS. This information allows the state to identify critical situations in the protection of endangered species by locating key habitats and areas of significant biodiversity that are not currently protected by the state (Smith et al., 2001). Additional remote sensing and GIS data such as the Multi-Resolution Land Characteristics Consortium (MRLC), USGS land use land cover data (LULC) and the National wetland inventory can also be applied to develop baseline inventories. These databases will not only help identify important resources throughout the state but also facilitate data sharing between state and federal agencies.

Projected Outcome: The creation and application of all of these databases will allow the DEC to identify and prioritize SGCNs and their habitats that lack sufficient distributional and abundance data.

STEP 2. IDENTIFY AND BEGIN ACQUISITION OF RELEVANT REMOTE SENSING AND GIS DATA

Application of GIS technology will facilitate the both the creation of a statewide inventory for target resources, and the integration of multiple databases to meet management needs. In addition, this technology will allow the state to prioritize target areas for site selection and create a more efficient and comprehensive sampling strategy. There are number of current remote sensing and GIS databases that will be applied. These include: GAP, LULC, MRLC, NYS Clearinghouse, New York State quadrangle maps and Cornell University geospatial data information repository (CUGIR). After reviewing and combining existing databases, the DEC will identify additional spatial data requirements such as: acquisition of current satellite imagery, improved vegetation cover maps, or application of higher resolution imagery for tracking rare communities. Development of a statewide protected lands GIS data layer, using property boundaries and meta-data from public agencies (federal, state, county, and municipal) and not-for-profit conservation organizations, will provide critical information showing where SGCN populations and their habitats have been conserved and where they may still be at risk.

Projected Outcome: Updated maps of target habitats, areas and watersheds in New York State

STEP 3. CREATE GEO-REFERENCED CENTRAL DATABASE THAT INCORPORATES EXISTING SGCN AND HABITAT DATA.

The data management and analysis portion of a monitoring program will require a substantial investment of agency resources to provide meaningful information (Vos et al., 2000). The DEC will devote significant time and finances to create a geo-referenced central data directory, or series of compatible databases, before a monitoring program is put in place. This will ensure an efficient, user-friendly, data management system. The monitoring committee (as defined in Step 1.), or an appropriate sub-committee, will identify database systems to be used in New York's resource monitoring program. In addition the state expects to hire a specialized manager who will oversee the creation, standardization and distribution of the database. This system will require either a centralized data repository, or series of compatible and cross-referenced databases, capable of allowing multiple users to access and submit data within a strict framework of data quality assurance. The data will also be formatted for statistical assessment and reporting. The stakeholder committee and database manager will draw from existing data management systems such as the: National Biological Information Infrastructure (NBII), National Park Service Vital Signs Monitoring Database, Long-Term Ecological Network, NatureServe and the New York Natural Heritage Program, and the Bird Population studies section of the USGS Patuxent Wildlife Research Center.

Projected Outcome: Appointment of a database manager who will be responsible for the creation of a centralized and accessible database for current and future monitoring efforts

STEP 4. USE BASELINE INFORMATION TO DEFINE PURPOSE, OBJECTIVES AND QUESTIONS IN MONITORING PROGRAM AND SUPPORT MANAGEMENT DECISIONS

After identifying and organizing existing data, the DEC will again hold workshops with key partners, stakeholders and experts who are knowledgeable about SGCNs and their habitats. These workshops will refine the purpose, define the objectives and pose the questions necessary for a successful monitoring program. This will be an iterative process that can be revised as new information becomes available (Gaines et al., 1999). Questions will be ranked based on their priority and will be both management and science relevant. Ecological indicators will be identified where appropriate.

Projected Outcome: Clear purpose, objectives and monitoring questions developed for implementation. Identification of possible environmental or SGCN indicators.

Phase 2

STEP 1. DESIGN IDEAL SAMPLING STRATEGY FOR INDIVIDUAL SPECIES, HABITATS, AND LONG TERM DATA COLLECTION

The monitoring and objectives outlined in Phase 1 will define the survey designs and methods of collection. Monitoring efforts will need to be done at multiple scales in order to provide broad context and evaluate effects of specific management actions. Statisticians and experts knowledgeable about target species/habitats and sampling design will be consulted throughout this development.

Habitat monitoring can be conducted at the watershed basin, landscape, or community level. The sampling strategy for habitat monitoring at the landscape or watershed scale will depend on existing GIS/remote sensing data. The sampling strategy at the community level will depend on biologically relevant indicators of habitat quality and identification of reference habitats in the best available condition. Rapid assessment techniques at IBIs will be fully reviewed at this stage for relevance and applicability.

Species monitoring may be conducted at several levels, including individual species, guild, or population. For some species, sampling strategy will be based on an existing structure, such as the Breeding Bird Atlas blocks and state quad maps. After evaluating existing data for SGCNs, the sampling strategy will incorporate direct measurement of abundance indices or presence/absence data. In order to incorporate a power analysis, pilot studies will be implemented to quantify spatial/temporal variability, if estimates are not available from the literature.

Data quality assurance (QA) protocols will be created for the data sampling frameworks. Existing QA programs will be reviewed for their relevance and application to the sampling strategy. Example QA strategies may include: DEC Analytical Services Protocol, Washington State Environmental Assessment Program: Quality Assurance, U.S. EPA's Quality Assurance Program.

Projected Outcome: Identification of sampling and data collection needs (volunteer vs. expert field work). Design and implementation of pilot studies

STEP 2. ACCOUNT FOR PROGRAM INFRASTRUCTURE AND SUPPORT

At this stage, the DEC will conduct a monitoring cost-benefit analysis. A full review of cost for maintaining existing databases, implementing pilot studies and supporting existing and new personnel will be created. This analysis will allow the agency to fulfill budget requirements while prioritizing projects with greatest conservation need. New projects will be implemented or scaled down depending on a number of factors including: project feasibility and need, budget requirements and effectiveness (power).

Projected Outcome: Cost benefit analysis will help refine data collection techniques and prioritize target resources

STEP 3. EVALUATE DATA ANALYSIS TECHNIQUES

Data analysis techniques will be designed to address specific monitoring objectives and questions. These techniques will influence how the data are collected, analyzed and integrated throughout the monitoring process. Statisticians and agency personnel who are knowledgeable about statistical techniques will be consulted throughout this process. Data analysis will occur at regular intervals and will be based on appropriate and current techniques.

Projected Outcome: Identification of appropriate statistical methods

STEP 4. ESTABLISH REPORTING FRAMEWORK

The DEC will establish a reporting format that builds on existing federal guidelines. Pittman-Robertson, Dingell-Johnson, or similar program reporting procedures will serve as useful prototypes for the development of an audience appropriate reporting scheme.

Projected Outcome: Documentation of how the state expects reports to be reviewed, published, and distributed

Phase 3

STEP 1. ANALYZE PILOT MONITORING DATA AND EVALUATE MANAGEMENT ACTIONS

Evaluation of resulting data will depend on the data collection techniques, design of study, and natural history of the target resource. Although no specific approach to analyzing the monitoring data can be formalized, there are a few important considerations that will affect both the statistical and management aspects of this process (Vos et al., 2000):

- Analyses will focus on testing specific hypotheses
- The most up to date and relevant statistical tests will be used
- Results should be directly linked to management actions
- Reliability of the analysis should be explicitly stated
- Results will be presented to managers, key partners and stakeholders in a meaningful and timely manner
- Alternative management choices should be clearly addressed

Projected Outcome: A comprehensive analysis of the status and distribution of SGCNs and their habitats.

STEP 2. EVALUATE RANKING OF TARGET RESOURCES

At this stage, the agency will begin to reevaluate the prioritization and ranking of target resources. As the cycle of the monitoring process continues, the DEC will again hold workshops with key partners to update and address the needs of SGCNs and their associated habitats. Objectives will be redefined and new questions will be created as information is available. Existing monitoring efforts will continue if the programs are both cost-effective and reliable.

Projected Outcome: Reassess the goals and targets for the DEC monitoring program in an adaptive management framework

STEP 3. PROPOSE CHANGES IN DATA COLLECTION AND MANAGEMENT BASED ON DATA ANALYSIS AND BUDGET NEEDS

After reevaluating and prioritizing target resources, the state will conduct programmatic evaluations to determine which monitoring efforts should be continued. Cost-effective monitoring efforts will be updated with new collection techniques, quality assurance practices and sampling needs. New monitoring or pilot projects will be implemented within budgetary constraints.

Projected Outcome: Strengthen the existing monitoring framework with new information and current budgetary constraints

STEP 4. REPORT RESULTS TO STAKEHOLDERS, PARTNERS AND THE PUBLIC

Regular reporting to key stakeholders, partners and the public is an important part of any policy oriented monitoring program. Creation of a broadly accessible database will allow data sharing among agency departments, NGOs and academic institutions. Workshops and meetings will also facilitate communication among key participants. At this time the CWCS will be updated with current progress, trends in species and habitats, GIS maps, as well as budget and management revisions. The CWCS will be publicly available and peer reviewed. The format for presentation and publication of results will depend on the target audience.

Projected Outcome: Creation of a publicly available and peer reviewed update of the CWCS with trend analysis and full transparency and data sharing (while maintaining appropriate protections for sensitive species)

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